

Claims

What is claimed is:

1. A cylinder assembly comprising:  
a cylinder body including an internal cavity therein;  
a piston and rod assembly disposed for axial movement within the internal cavity of the cylinder body, the piston and rod assembly having an axial passage extending therein; and  
a tubular element received within the axial passage of the piston and rod assembly, at least a portion of the tubular element extending out of the axial passage and into the internal cavity of the cylinder body between the axial passage and a wall of the cylinder body.
2. The cylinder assembly of claim 1, wherein the tubular element is slidably received within the axial passage of the piston and rod assembly and is affixed to or integrally formed with the cylinder body.
3. The cylinder assembly of claim 1, wherein:  
the cylinder body has a first end and a second end, the first end having an opening therein;  
a portion of the piston and rod assembly extends through the opening in the first end of the cylinder body; and  
the tubular element extends into the internal cavity of the cylinder body between the axial passage and the second end of the cylinder body.
4. The cylinder assembly of claim 3, including:  
a source of fluid disposed external to the cylinder body;  
wherein:

the tubular element is affixed to the second end of the cylinder body and is slidably and sealingly received within the axial passage of the piston and rod assembly; and

the tubular element includes a fluid passage therein, the fluid passage fluidly communicating the axial passage of the piston and rod assembly with the source of fluid disposed external to the cylinder body.

5. The cylinder assembly of claim 1, including:

a source of pressurized fluid;

wherein the tubular element includes a fluid passage therein, the fluid passage fluidly communicating the axial passage of the piston and rod assembly with the source of pressurized fluid.

6. The cylinder assembly of claim 5, wherein the source of pressurized fluid is an accumulator.

7. The cylinder assembly of claim 6, including:

a fluid reservoir fluidly connected to the accumulator; and

a valve disposed between the accumulator and the fluid reservoir, the valve being operable to prevent fluid passage from the accumulator to the fluid reservoir when the accumulator pressure is below a threshold pressure.

8. The cylinder assembly of claim 5, wherein the source of pressurized fluid is a fluid pump.

9. A fluid system comprising:

a cylinder body including an internal cavity therein;

a piston and rod assembly disposed for axial movement within the internal cavity of the cylinder body, the piston and rod assembly having an axial

passage extending therein, the piston and rod assembly including a piston having a rod side and a head side;

    a tubular element received within the axial passage of the piston and rod assembly, at least a portion of the tubular element extending out of the axial passage and into the internal cavity of the cylinder body between the axial passage and a wall of the cylinder body, the tubular element having a fluid passage therein;

    a source of fluid in fluid communication with the head side of the piston; and

    a source of fluid in fluid communication with the axial passage of the piston and rod assembly through the fluid passage of the tubular element.

10. The fluid system of claim 9, wherein the source of fluid in fluid communication with the axial passage of the piston and rod assembly through the fluid passage of the tubular element is a fluid pump.

11. The fluid system of claim 10, wherein the source of fluid in fluid communication with the head side of the piston is the fluid pump.

12. The fluid system of claim 9, wherein the source of fluid in fluid communication with the axial passage of the piston and rod assembly through the fluid passage of the tubular element is an accumulator.

13. The fluid system of claim 12, wherein the source of fluid in fluid communication with the head side of the piston is a fluid pump.

14. The fluid system of claim 13, including a control valve, the axial passage of the piston and rod assembly being fluidly connected with the fluid pump through the control valve.

15. The fluid system of claim 14, wherein the control valve is operable to prevent or restrict fluid from passing from the fluid pump to the axial passage of the piston and rod assembly when the pressure of fluid from the fluid pump is below a threshold pressure.

16. The fluid system of claim 14, wherein the control valve is an electro-hydraulic valve that is operable to selectively control the passage of fluid between the fluid pump and the axial passage of the piston and rod assembly.

17. The fluid system of claim 13, wherein the accumulator is fluidly connected with the fluid pump through a control valve.

18. The fluid system of claim 9, including:  
a control valve;  
wherein the axial passage of the piston and rod assembly is fluidly connected through the control valve with the source of fluid in fluid communication with the head side of the piston.

19. The fluid system of claim 18, wherein the control valve is operable to (i) prevent or restrict fluid from passing from the source of fluid in fluid communication with the head side of the piston to the axial passage of the piston and rod assembly when the pressure of fluid coming from the source of fluid in fluid communication with the head side of the piston is below a threshold pressure, and (ii) allow fluid to pass from the source of fluid in fluid communication with the head side of the piston to the axial passage of the piston and rod assembly when the pressure of the fluid coming from the source of fluid

in fluid communication with the head side of the piston exceeds a threshold pressure.

20. The fluid system of claim 18, including:  
an accumulator fluidly connected with the control valve;  
wherein the control valve is operable to block fluid communication between the accumulator and the axial passage of the piston and rod assembly.

21. A method for actuating a fluid actuator including a cylinder body with an internal cavity therein, and a piston and rod assembly having an axial passage extending therein, the piston and rod assembly being disposed for axial movement within the internal cavity of the cylinder body, the method comprising:

creating a first urging force on the piston and rod assembly in an axial direction by directing pressurized fluid from a fluid source into the cylinder body and upon a first side of a piston of the piston and rod assembly;

directing fluid from a source of fluid into the axial passage of the piston and rod assembly as the piston and rod assembly moves in the axial direction; and

preventing the pressurized fluid that is creating the first urging force on the piston and rod assembly from substantially communicating within the cylinder body with the fluid within the axial passage of the piston and rod assembly.

22. The method of claim 21, including creating a second urging force on the piston and rod assembly in the axial direction by directing pressurized fluid into the axial passage of the piston and rod assembly.

23. The method of claim 22, wherein the step of creating a second urging force on the piston and rod assembly includes directing pressurized fluid through a tubular element slidably disposed within the axial passage of the piston and rod assembly and extending out of the axial passage and into the internal cavity of the cylinder body between the axial passage and a wall of the cylinder body.

24. The method of claim 22, including:

preventing the pressurized fluid that creates the first urging force from contributing to the second urging force when the pressure of the pressurized fluid that creates the first urging force is below a threshold pressure; and

allowing the pressurized fluid that creates the first urging force to contribute to the second urging force when the pressure of the pressurized fluid that creates the first urging force exceeds a threshold pressure.

25. The method of claim 21, including:

eliminating or reducing the first urging force; and

directing fluid from the axial passage of the piston and rod assembly to a fluid reservoir.

26. The method of claim 25, wherein the step of directing fluid from the axial passage of the piston and rod assembly includes directing fluid from the axial passage of the piston and rod assembly to an accumulator.

27. The method of claim 21, including:

eliminating or reducing the first urging force; and

directing fluid from the axial passage of the piston and rod assembly to a fluid reservoir through a tubular element slidably disposed within the axial passage of the piston and rod assembly and extending out of the axial

passage and into the internal cavity of the cylinder body between the axial passage and a wall of the cylinder body.

28. The method of claim 27, wherein the step of directing fluid from the axial passage of the piston and rod assembly to a fluid reservoir includes directing fluid from the axial passage of the piston and rod assembly to an accumulator.

29. The method of claim 21, including using the first urging force to lift a work implement.

30. The method of claim 21, including using the first urging force to lower a work implement.

31. The method of claim 21, including directing fluid out of a first port of the cylinder body, into a second port of the cylinder body, and toward the first side of the piston of the piston and rod assembly.